Cas 1905EP

(12) UK Patent Application (19) GB (11) 2 201 266 (13) A

(43) Application published 24 Aug 1988

(21) Application No 8729985

(22) Date of filing 23 Dec 1987

(30) Priority data
(31) 8630735 (32) 23 Dec 1986 (33) GB
8713469 9 Jun 1987

(71) Applicant
Upperpace Limited

(Incorporated In United Kingdom)

Brazenose House, Lincoln Square, Manchester

(72) Inventors
David Christopher Perry
Susan Jane Comfort

(74) Agent and/or Address for Service
Page White & Farrer
5 Plough Place, New Fetter Lane, London, EC4A 1HY

(51) INT CL⁴
G04G 1/00

(52) Domestic classification (Edition J):
G3T 101 301 407 A3 AAA QA QB
A3H 3
U1S 2203 2205 A3H G3T

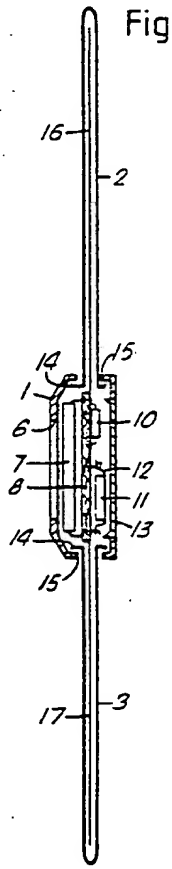
(56) Documents cited
GB A 2171821 GB A 2159304 GB A 2102228
EP A2 0184606 EP A1 0161545

(58) Field of search
G3T
Selected US specifications from IPC sub-class
G04G

(54) A radio paging watch

(57) A radio paging watch including a digital watch circuit 8 with a liquid crystal display 7, a radio receiver 10 and decoder coupled to the display, and a receiver antenna 16, 17 which is positioned to provide an effective signal to the receiver whether or not the watch is in use.

Fig.2.



GB 2 201 266 A

The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

2201266

Fig.1.

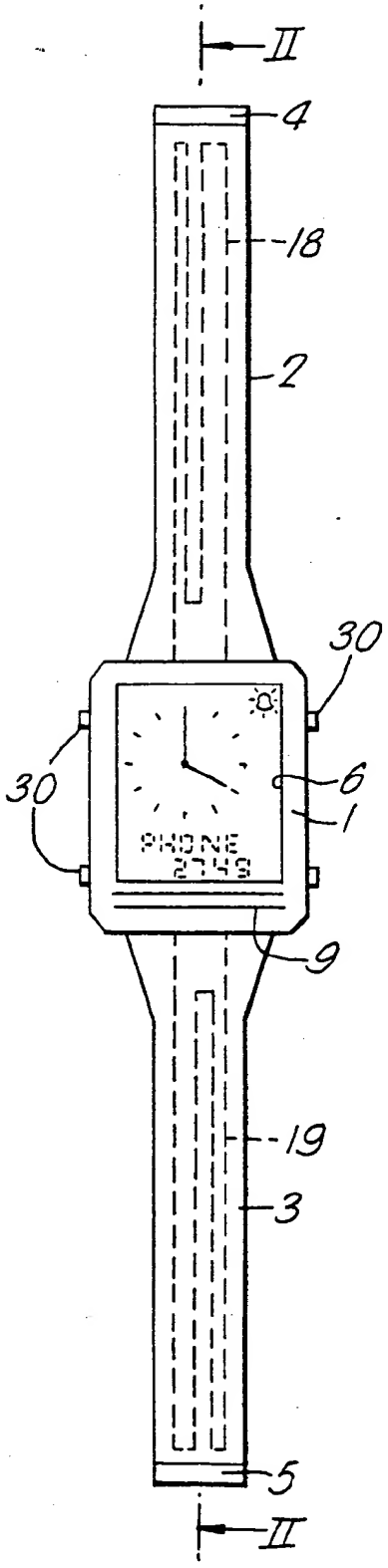
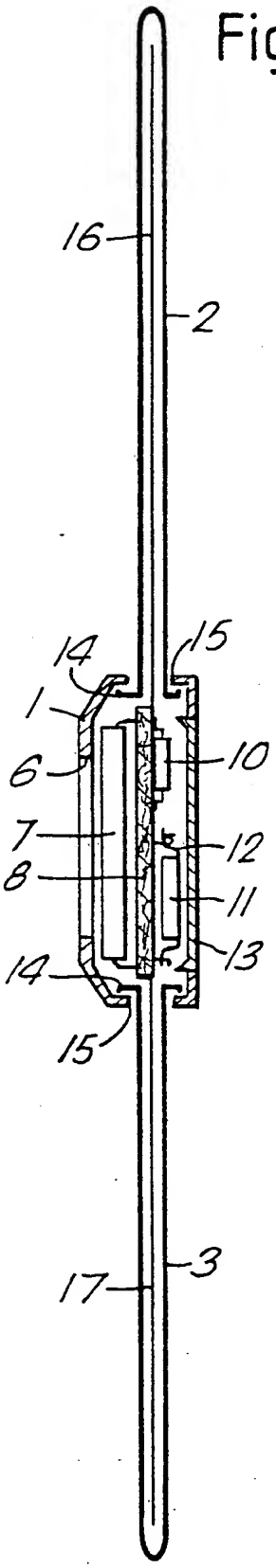


Fig.2.



2201260

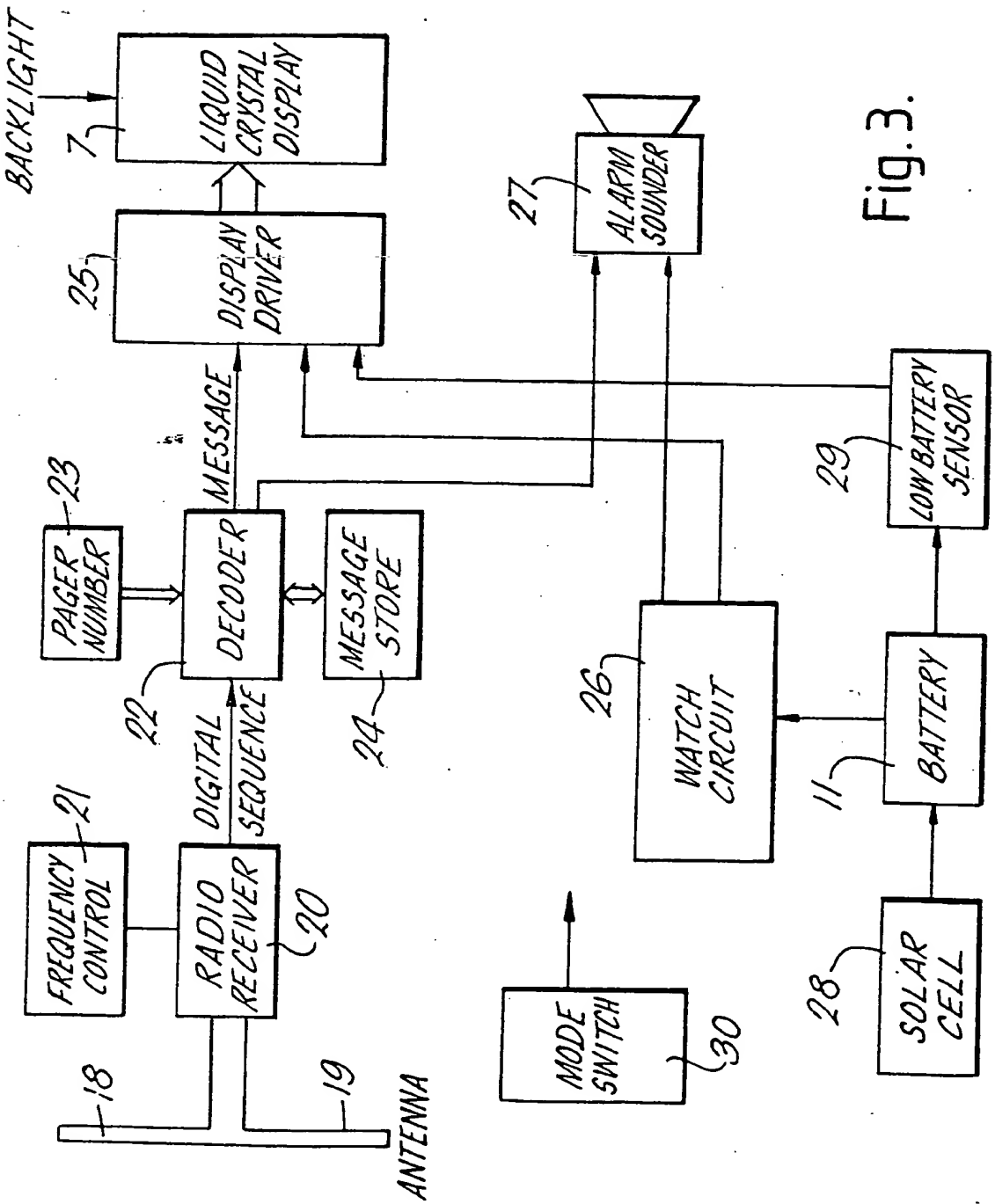


Fig. 3.

Fig.4.

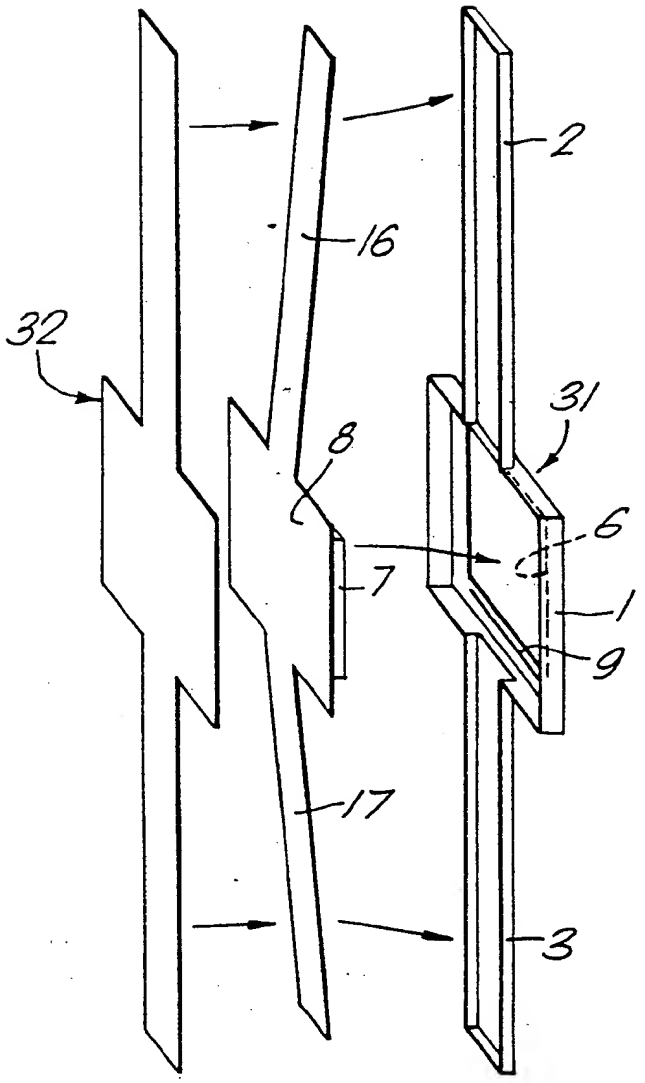


Fig.5a.

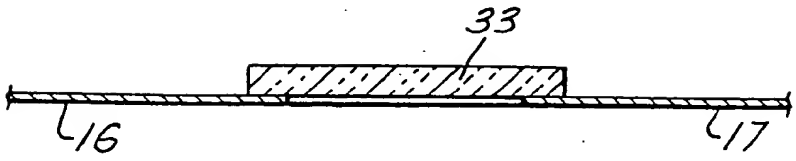


Fig.5b.

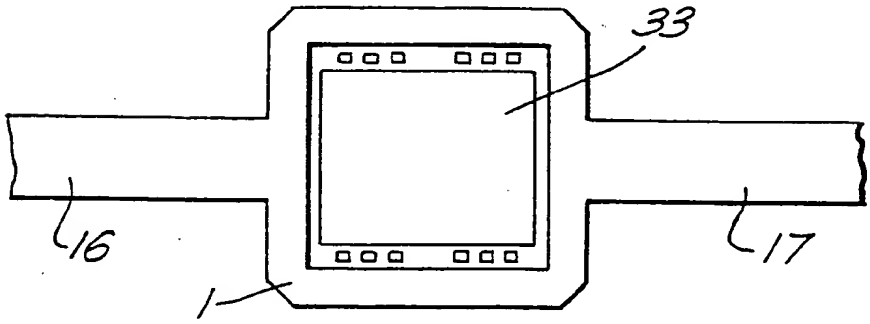
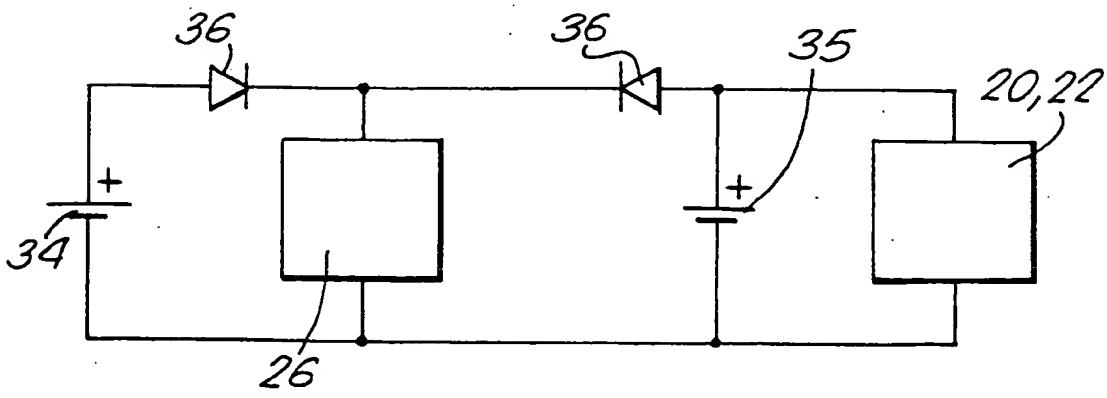


Fig.6.



2201266

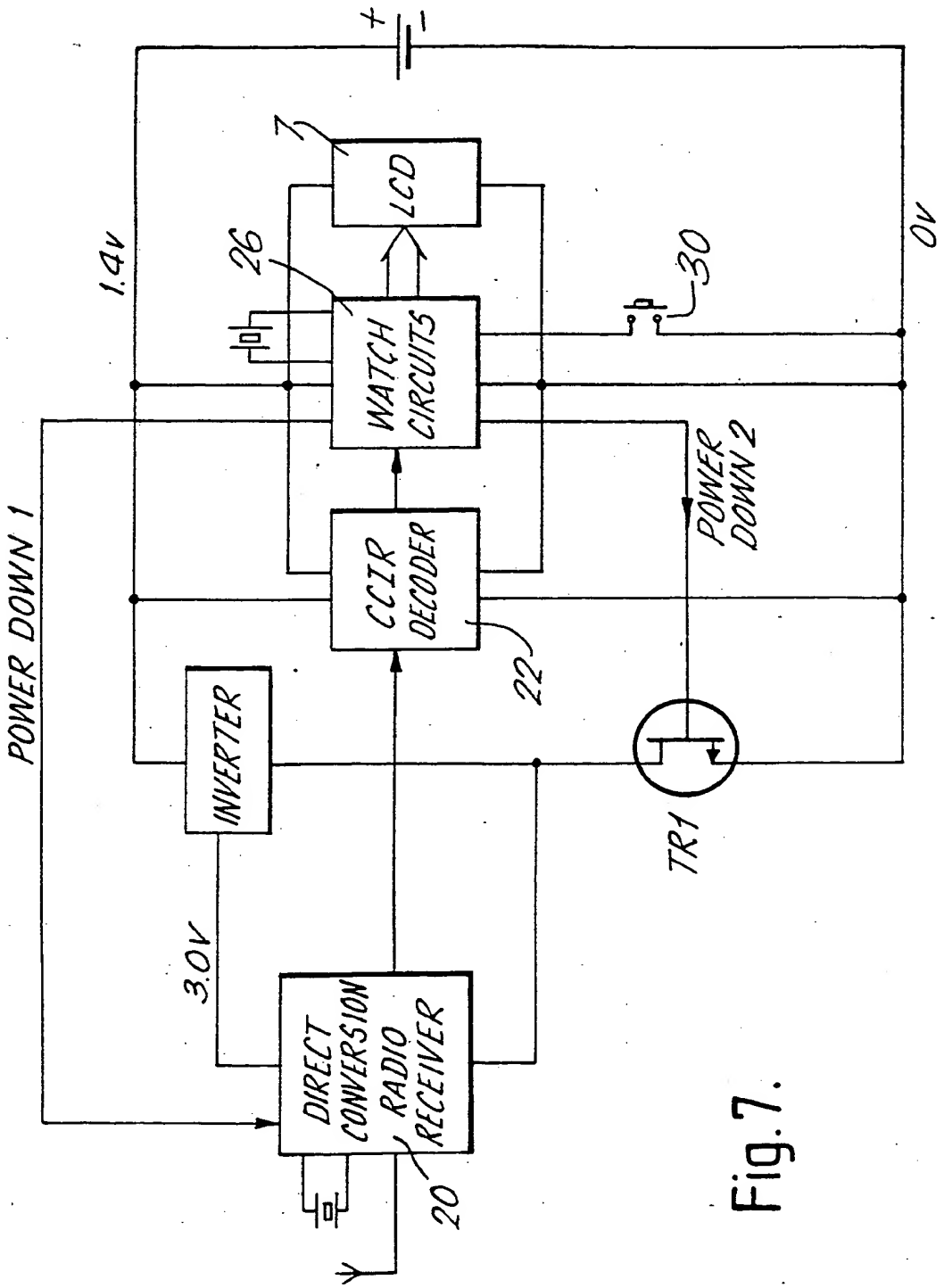


Fig. 7.

2201266

A Radio Paging Watch

This invention relates to radio paging receivers and more particularly to a radio paging watch.

Traditional radio paging receivers are pocket-size or clip onto the clothing of the user. The technology exists to produce a radio paging receiver of the size of a credit card, but all existing radio paging receivers have a key failing in that it is easy for the user to forget to wear or carry the receiver.

The present invention proposes to incorporate a radio paging receiver into a digital watch. All the usual features of a digital watch are retained including a display and an alarm sounder, the watch having the usual time, date, alarm and stopwatch features.

It is a main object of the present invention to provide a radio paging watch which is a fully functional digital watch, which includes all required features of a paging facility and which would be wanted to be worn and would be unlikely to be forgotten by the user.

A further object of the invention is to provide, as a radio paging receiver, a watch which embodies an extended receiver antenna in an auxiliary part of the watch such as a wristwatch strap or bracelet or a supporting thong or strap of a fob watch or pocket watch.

According to the invention there is provided a radio paging watch including a digital watch circuit with a liquid crystal display, a radio receiver and decoder coupled to the display, and a receiver antenna which is positioned to provide an effective signal to the receiver whether or not the watch is in use.

The antenna may be contained, for example looped, within the watch case. Preferably the antenna is embodied in the strap of the watch.

In a preferred embodiment, the radio paging watch is a wristwatch with the antenna embodied in the strap of the wristwatch.

When the wristwatch strap is in two parts which are fastened by a buckle or clasp, the antenna may be a dipole the two poles of which respectively extend along two parts of the wristwatch strap.

The wristwatch strap may be in two parts joined by a safety chain or by a folding clasp and the antenna may be a loop antenna embodied in the strap which loop is completed when the strap is fastened on the wrist of the wearer.

In specific embodiments of the invention the antenna or interconnection is on a flexible printed circuit which is embodied in the strap.

The antenna may comprise two flexible printed circuit portions which are bonded to a printed circuit board which carries the digital watch components, the liquid crystal display and the radio receiver and decoder.

Alternatively, when the strap is an elasticated bracelet the antenna may be concertinaed within the bracelet.

In each embodiment the decoder may be operable to provide an output to the liquid crystal display and to an alarm sounder circuit of the watch, thereby providing an audible alarm when a decoded message is displayed.

Some embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a front view of a radio paging watch according to the invention,

Figure 2 is a section on line II-II of Figure 1,

Figure 3 is a block diagram of an integrated circuit of the watch comprising a digital watch circuit with display and radio paging circuits, and

Figure 4 illustrates diagrammatically the assembly of a simple radio paging watch according to the invention.

Figures 5a and 5b illustrate an embodiment of the invention wherein a hybrid substrate is used.

Figure 6 shows a radio paging circuit which is powered by two batteries.

Figure 7 is a block diagram showing dual isolation of the radio receiver circuits of a radio paging watch.

One embodiment of a radio paging watch according to the invention is illustrated in Figures 1 and 2. The watch is a conventional digital wristwatch contained in a watch case 1 to which two parts 2 and 3 of a flexible wristwatch strap are connected. The strap is fastened on the wrist of the wearer by a locking clasp or buckle the two parts of which are indicated at 4 and 5.

The watch case has a front window 6 behind which a liquid crystal display 7 is mounted on a printed circuit board 8. The liquid crystal display is operable conventionally to display the time by minutes and hour hands or as a numerical display of the time and the date. A lower part of the liquid crystal display 7 is dedicated to the display of pager information, for example a request to phone an extension number, as indicated in Figure 1, and an indication of an alarm as indicated in the upper right hand corner of the display.

Other displays may be "visitor in reception", a share price, or a currency exchange rate.

The radio paging watch can thus be adapted to the needs of all current users of radio paging receivers, including doctors, nurses, business executives, factory floor managers, and stock brokers. Also the paging watch in this embodiment will extend the field of users of paging receivers beyond current users with a very wide potential.

The lower edge of the watch case has conventional acoustic slots 9, if needed, behind which an alarm sounder circuit is mounted to provide an audible signal that a message is being displayed.

In the example of Figure 1, all the radio paging and watch circuits are embodied in a custom integrated circuit 10 on the printed circuit board 8. A battery 11 is held by a strap 12 on the printed circuit board 8 and the circuit may include a battery-low-sensor indicating that the battery is failing. An access panel 13 closes the rear of the watch case and provides access for changing the battery.

The parts 2 and 3 of the watch strap are both of sandwich construction with flanged ends 14 which hold the strap within slots 15 in the watch case. Each part 2 and 3 of the watch strap contains a flexible printed circuit strip respectively 16 and 17 having a flexible base similar to photographic film on which copper tracks are printed. The ends of the flexible printed circuit strips 16 and 17 are bonded to the rigid printed circuit board 8.

In the embodiment of the invention illustrated in Figures 1 and 2 each flexible printed circuit strip 16 and 17 has printed thereon one pole respectively 18 and 19 of a dipole antenna. Each pole 18, 19 of the antenna is a folded circuit which is connected directly into the integrated circuit 10 on the printed circuit board 8. This extensive flexible antenna shape provides more sensitive reception of paging signals than has been possible hitherto.

The dipole antenna 18, 19 is also indicated in Figure 3 and is directly connected to an RF receiver 20 where the paging signal is

converted into a digitally coded signal train which conventionally comprises a digital sequence consisting of a synchronisation pattern, a pager code number, and then the paging message to be displayed by the liquid crystal display 7. The frequency sensitivity and accuracy of the receiver 20 are controlled by a stable frequency control reference 21, for example a crystal oscillator.

The digital sequence from the receiver 20 is fed to a decoder 22 which firstly looks for the synchronisation pattern and then determines whether the message is destined for this particular receiver by comparing the incoming pager code number of the digital signal with its own pager number provided by a circuit 23. If this comparison is positive the message is decoded, for example by accessing a particular message in a message store 24, and the message is fed to a display driver 25 which drives the liquid crystal display 7. The message is immediately displayed on the watch face, for example an instruction to phone a particular extension as indicated in Figure 1. The display of the message does not interfere with the time display which is fed digitally to the display driver 25 by a conventional digital watch circuit 26. The watch circuit also has an output to an alarm sounder 27 which is mounted behind the acoustic slots 9 in the watch case. The alarm 27 has a second input from the decoder 22 so that an audible alarm is sounded when the decoder has selected a paging message for display.

The battery 11 is connected to the digital watch circuit 26. If the battery 11 is rechargeable it may be supplied by a solar cell 28. The battery is also connected through a low battery sensor 29 to the display driver 25 so that a warning of impending battery failure may be displayed. In practice the battery life is dependent on the nature of the alarm sounder and back-light for the liquid crystal display and how often they are used.

The watch includes the usual multi-function mode switches which normally form part of a digital watch and which are indicated at 30 in

Figure 1. The mode switches can be used to disable the receiver, or the alarm sounder and to store and recall messages, suitable provisions being provided in the integrated circuit 10.

An advantage of using flexible printed circuits for carrying the antenna is that it allows all the connections between the electronic components and the antenna to be preformed at one stage with the flexible printed circuit strips bonded to the rigid printed circuit board.

Figure 4 illustrates a simple radio paging watch assembly in which the watch case and strap are integrally moulded from plastics material. A single plastic moulding 31 provides the front of the watch case 1 and the watch strap. The circuit board 8 with the antenna carried on flexible printed circuit strips, which has been entirely preformed and has a battery in place, is then fitted into the moulded front part 31 and the case and strap are closed by a rear cover panel 32 which is clipped into the main part 31 of the case and retains the printed circuit board and battery in position behind the window of the watch case and encloses the flexible antenna strips 16 and 17 between the flexible parts of the strap.

The panel 32 includes an access window to permit access to replace the battery. The flexible strap may be completed with a cosmetic covering which could also carry buckle or clasp components.

The antenna on the flexible printed circuit strips may comprise two parts of a loop aerial which are coupled when the strap is fastened on the wrist of the wearer by a capacitive coupling provided by metal buckle or clasp parts, or by a safety chain which connects the two parts of the wristwatch strap together or by a folding clasp which completes the coupling of the loop when the clasp is closed on the wrist of the wearer.

The watch may have an elasticated bracelet with the antenna on flexible strips concertinaed within the bracelet, the antenna being either of dipole or loop form.

Most users of radio paging receivers wear a wristwatch, but the invention may also be applied to other types of watch, for example a nurses fob watch which usually hangs from a brooch by a strap or thong in which the antenna may be embodied directly connected to the integrated circuit within the watch case. Some users may not be able to wear a wristwatch but prefer a pocket watch which may also take the form of a digital watch to which a chain or thong is connected and the antenna may be embodied in an appropriate flexible thong connected to a pocket watch.

In other embodiments the antenna may be looped within the watch case itself, the case being made of appropriate material, usually moulded plastics material.

The radio paging equipment, being embodied within a watch case is thus waterproof, shockproof and can be made sterilisable and intrinsically safe as well as being made aesthetically pleasing and an item the user would want to wear so that there is little risk of it being forgotten. The physical implementation of the radio paging equipment with watch circuits in a flexible manner and with mixed analog and digital custom integrated circuits provides a radio paging receiver which can be made at much lower production costs than existing paging receivers, particularly when employing a plastic moulded case as indicated in Figure 4.

The watch may include a memory for storing messages for future reference. In this way the watch may provide silent operation whereby messages are saved within the watch and recalled at the convenience of the user. The watch may incorporate means for providing an alarm sound or signal at a set time interval after a message is received if the receipt of the message has not been acknowledged by the user. The

watch may include calculator features including calculator keys usable as a telephone style push-button key pad together with means to generate multi-frequency or dual-tone multi-frequency tones from an appropriate alarm sounding device. These tones may be used to generate a personal identification number or a code message which can be transmitted from the watch over as normal acoustic telephone.

Extended battery life can be achieved both by the combination of the rechargeable battery 11 with a solar cell 28 as indicated in Figure 3 together with "strobing" of the RF receiver 22.

The battery lifetime may be extended by using the timing circuitry in the watch to operate a time switch to switch on and off those circuits within the radio paging watch which have more significant power consumption. In particular the radio receiver and decoder may be switched on and off one or more times a day and optionally at weekends or holiday periods so as to minimise the power consumption during periods when receipt of messages is not required. Such a time control switch would enable the receiver to consume power only during specified working hours if desired. The on and off times of such a switch control may be programmed by the user in a manner similar to an alarm time on a conventional digital watch.

The watch may incorporate one or more rechargeable power sources and in this case an inductive loop circuit may be provided for charging the or each power source. This may comprise a loop of one or more turns included with the antenna in the watch pager so as to act as a secondary of a transformer linked with a primary in a charging unit. In this way the watch may be placed upon a charger unit and electromagnetically coupled so as to be recharged without the need for a plug-in unit. The charging unit could be powered from a mains supply or any other suitable source.

In a further embodiment shown in Figure 6 the watch pager can be powered from two batteries, one 34 primarily for the watch and one 35

for the paging receiver. The batteries are connected with blocking diodes 36. The advantage of this method is that the paging receiver battery 35, which is likely to run down more often, can be replaced without the loss of the time, date and other specific information. This means that the paging receiver battery 35 can be conveniently replaced, even if it does run down quickly.

Furthermore, the radio receiver circuits can be "double-isolated", such that leakage current when the radio receiver is off, is minimised. This is achieved by removing the bias from the radio circuits as the "first isolation", and fully switching off the power for the "second isolation". The circuit in Figure 7 shows the arrangement with signal POWER DOWN 1 being a conventional signal to the circuit to remove the bias, and signal POWER DOWN 2 controlling the Field Effect Transistor TR1 as a power supply switch. The advantage of the dual isolation is that radio receivers, particularly those of a "Direct-Conversion" type, cannot be totally powered down when searching for a signal on-air but can have their bias removed. The POWER DOWN 2 signal would only be activated when the radio receiver is totally out of use, at night for instance, under the control of a "Timer" as previously described.

In the example of Figures 1 and 2 all the radio and watch circuit components are formed in an integrated circuit on the printed circuit board 8. However in some cases it may be preferable to use a hybrid implementation in which the flexible printed circuit boards 16,17 are retained but a hybrid substrate (such as ceramic or alumina) is used in place of the rigid printed circuit board 8. The radio receiver may not be provided in one integrated circuit and a number of separate components may be provided including transistors, crystals, resistors, capacitors and inductors. Of these combinations of inductors and capacitors forming a tuned circuit are most critical to the overall performance of the receiver.

Onto the hybrid substrate 33 the integrated circuit or circuits and transistors are mounted directly by bonded die; resistors and

inductors are printed onto the substrate 33 using Thick or Thin Film techniques and the remaining components are mounted on the hybrid in a "surface-mount" fashion. The hybrid also offers a more controlled environment for the radio frequency parts of the circuit.

Also irrespective of whether a rigid printed circuit board 8 or a hybrid substrate 33 are used, electrical copmponents of low physical height may also be mounted on the flexible part of the circuit 16,17. The flexible circuit is used, in this situation as an "overflow" packaging area.

The radio paging watch of the invention may conform to the internationally adopted standard code for digital radio paging. Further the watch of the invention, by using modern plastics moulding techniques can produce flexible and durable watches in different fashion colours to suit different marketing applications. All the facilities of modern digital watches may be retained by the use of suitable integrated circuits. Such watch functions are the display of time as a hand display or a numerical display, display of date, stopwatch, alarm, hourly chimes, the provision of a back-light, and calculator and telephone number memory.

In addition all pager functions may be retained including alarm sounds and vibrations, coded into different sequences; individual messages such as phone numbers, extension numbers and textual messages; and broadcast messages to all of a group of receivers for example exchange rates, stock prices or warnings.

It has been previously described that the radio paging eatch can be configured to individual requirements, such as pager on and off times, silent, message storage etc. Off air messages may be coded to reset this information for an individual. Such a system may be initiated by a phone call to activate the data transmission, for example. Such setup information may also include the correct time to keep the watch accurate. This "Timecheck" may be sent periodically and automatically to all pagers as part of the service.

Claims.

1. A radio paging watch including a digital watch circuit with a liquid crystal display, a radio receiver and decoder coupled to the display, and a receiver antenna which is positioned to provide an effective signal to the receiver whether or not the watch is in use.

2. A watch as claimed in claim 1, in which the antenna is embodied in the strap of the watch.

3. A watch as claimed in claim 2, which is a wristwatch with the antenna embodied in the strap of the wristwatch.

4. A watch as claimed in claim 3, wherein the antenna is a dipole the two poles of which respectively extend along two parts of the wristwatch strap.

5. A watch as claimed in claim 3, wherein the antenna is a loop antenna embodied in the strap, which loop is completed when the strap is fastened on the wrist of the wearer.

6. A watch as claimed in any one of claims 3 to 5, wherein the antenna or interconnection is on a flexible printed circuit which is embodied in the strap.

7. A watch as claimed in claim 6, wherein the antenna comprises two flexible printed circuit portions which are bonded to a printed circuit board which carries the digital watch components, the liquid crystal display and the radio receiver and decoder.

8. A watch according to claim 6 wherein printed circuit board means are located between a front case member and a rear panel member, said printed circuit board means providing a central printed circuit board carrying at least some of the watch components and printed circuit board portions extending on opposite sides of said central printed

circuit board for location within the strap and providing said antenna.

9. A watch as claimed in any one of claims 3 to 5, wherein the strap is an elasticated bracelet and the antenna is concertinaed within the bracelet.

10. A watch as claimed in any one of claims 1 to 9, wherein the decoder is operable to provide an output to the liquid crystal display and to an alarm sounder circuit of the watch, thereby providing an audible alarm when a decoded message is displayed.

11. A watch as claimed in any of the preceding claims further comprising a memory for storing any message received.

12. A watch as claimed in any of the preceding claims further comprising a push-button key pad and means for generating a coded message signal which can be transmitted from the watch.

13. A watch as claimed in claim 12 wherein the means for generating the message signal generates a message which can be transmitted over a normal acoustic telephone.

14. A watch as claimed in any of the preceding claims wherein a time switch is provided in the watch in order to switch on and off selected circuits within the watch at selected times.

15. A watch as claimed in any of the preceding claims incorporating an inductive loop circuit for recharging a power supply with the paging watch.

16. A watch as claimed in claim 6 or claim 8 wherein the antenna comprises a flexible printed circuit connected to a substrate which carries at least some of the digital watch components, the radio receiver components and decoder.

17. A watch as claimed in any of claims 6, 7, 8 or 16, wherein electrical components are mounted on the flexible printed circuit.

18. A watch as claimed in any of the preceding claims wherein the paging receiver is powered by one battery and a further battery is provided for the watch circuit.

19. A watch as claimed in any of the preceding claims wherein the watch circuit includes means for isolating the radio receiver by removing the bias from the radio receiver.

20. A radio paging watch substantially as herein described with reference to the accompanying drawings.